What is claimed is:

1. An electro-magnetic actuator for controlling a clutch to be installed in a vehicle, the actuator comprising:

a shaft having a first end portion and a second end portion;

a nut having an inner peripheral surface and an outer peripheral surface, said inner peripheral surface coupled with said first end portion of said shaft;

a bearing disposed around said second end portion of said shaft for rotatably supporting said shaft;

an electrical coil disposed around said shaft between said nut and said bearing for receiving electrical current and producing magnetic flux; and

a ferromagnetic can disposed around said shaft having a peripheral surface extending between said shaft and said outer peripheral surface of said nut for establishing a path for magnetic flux flow there between,

said peripheral surface of said can interposed between said electrical coil and said bearing partitioning said electrical coil inside said can and said bearing outside said can.

2. The actuator asset forth in claim 1 including a bushing disposed between said first end portion of said shaft and said inner peripheral surface of said nut for coupling said shaft and said nut.

3. The actuator as set forth in claim 2 wherein said bushing is formed from a non-magnetic material for prohibiting magnetic flux flow directly between said first end portion of said shaft and said inner peripheral surface of said nut.

4. The actuator as set forth in claim 1 wherein magnetic flux produced by said electrical coil

flows in a loop about said electrical coil, said magnetic flux flow loop extending from said first end portion of said shaft through said shaft to said second end portion of said shaft, from said second end portion of said shaft along said peripheral surface of said can between said electrical coil and said bearing to said outer peripheral surface of said nut, from said outer peripheral surface of said nut through said nut to said inner peripheral surface of said nut, and between said inner peripheral surface of said nut and said first end portion of said shaft along an arch-shaped airborne path portion, said airborne path portion arching outwardly from the actuator.

5. The actuator as set forth in claim 4 wherein said arch-shaped airborne path portion of said magnetic flux flow loop applies a magnetic force onto a portion of the clutch when said actuator is assembled to the clutch.

6. The actuator as set forth in claim 1 wherein said peripheral surface of said can includes a first wall extending radially outward from said second end portion of said shaft between said electrical coil and said bearing to a distal end of said first wall located beyond said electrical coil, and a second wall extending axially with respect to said shaft between said distal end of said first wall and said outer peripheral surface of said nut.

7. The actuator as set forth in claim 1 wherein said bearing is an insert molded bearing fixed inside said actuator.

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8. A combination of an electro-magnetic actuator and a viscous fluid clutch installed in a vehicle, the clutch having an armature plate for

controlling fluid coupling within the clutch, the actuator comprising:

a shaft having a first end portion and a second end portion;

a nut having an inner peripheral surface and an outer peripheral surface, said inner peripheral surface coupled with said first end portion of said shaft;

a bearing disposed around said second end portion of said shaft for rotatably supporting said shaft;

an electrical coil disposed around said shaft between said nut and said bearing for receiving electrical current and producing magnetic flux; and

a ferromagnetic can disposed around said shaft having a peripheral surface extending between said shaft and said outer peripheral surface of said nut for establishing a path for magnetic flux flow there between,

said peripheral surface of said bearing can interpose between said electrical coil and said bearing partitioning said electrical coil inside said can and said bearing outside said can.

10. The combination as set forth in claim 9 wherein the actuator includes a bushing disposed between said first end portion of said shaft and said inner peripheral surface of said nut for coupling said shaft and said nut.

11. The combination as set forth in claim 10 wherein said bushing is formed from a non-magnetic material for prohibiting magnetic flux flow directly between said first end portion of said shaft and said inner peripheral surface of said nut.

12. The combination as set forth in claim 9 wherein magnetic flux produced by said electrical coil flows in a loop about said electrical coil, said magnetic

flux flow loop extending from said first end portion of said shaft through said shaft to said second end portion of said shaft, from said second end portion of said shaft along said peripheral surface of said can between said electrical coil and said bearing to said outer peripheral surface of said nut, from said outer peripheral surface of said nut through said nut to said inner peripheral surface of said nut, and between said inner peripheral surface of said nut and said first end portion of said shaft along an arch-shaped airborne path portion, said airborne path portion arching outwardly from the actuator.

13 12. The combination as set forth in claim 11 wherein said arch-shaped airborne path portion of said magnetic flux flow loop applies a magnetic force onto the armature plate of the clutch displacing the armature plate toward the actuator and actuating the clutch.

14 13. The combination as set forth in claim 9 wherein said peripheral surface of said can includes a first wall extending radially outward from said second end portion of said shaft between said electrical coil and said bearing to a distal end of said first wall located beyond said electrical coil, and a second wall extending axially with respect to said shaft between said distal end of said first wall and said outer peripheral surface of said nut.

15 14. The combination as set forth in claim 9 wherein said bearing is an insert molded bearing fixed inside said actuator.

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